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bind to [said central metal atom] a metal atom selected from the group consisting of molybdenum, tungsten, and chromium, wherein said heterocyclic group is optionally substituted with one or more groups selected from alkyl, alkenyl, aryl, aralkyl, alkoxy, aryloxy, acyl, acyloxy, amide, tertiary amine, nitro, or halogen, and may be fused to one or more additional rings,

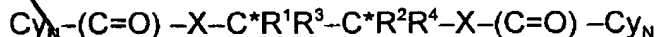
with a hexacoordinate complex of a metal selected from tungsten (0), chromium (0), and molybdenum(0),

whereby said complex undergoes a ligand exchange reaction, such that L¹ becomes coordinated to said metal [atom];

wherein said composition is effective to catalyze the enantioselective alkylation of an allyl group bearing a leaving group at its allylic position.

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55. The composition of claim 17, wherein said chiral centers are connected by a direct bond or by a chain of one to three atoms comprising linkages selected from alkyl (carbon-carbon), alkyl ether (carbon-oxygen), alkyl amino (carbon-nitrogen), or a combination thereof.--

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56. The composition of claim 55, wherein said ligand L₁ has the structure



wherein said chiral centers are connected by a direct bond, R¹ and R² are as defined above, R³ and R⁴ are hydrogen, and binding groups Cy_N are as defined above.--

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57. A catalytic organometallic composition, wherein the composition is the product of a process which comprises

contacting, in a suitable solvent, a chiral ligand L¹ comprising:

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(a) an axially chiral 1,1'-binaphthyl system, said system substituted at its 2 position and at its 2' position with a group X selected from -O- or -NR-, where R is hydrogen or lower alkyl, and, linked to each said group X,

(b) a binding group Cy_N comprising a heterocyclic group having a ring nitrogen atom effective to bind to a metal atom selected from the group consisting of molybdenum, tungsten, and chromium, wherein said heterocyclic group is optionally substituted with one or more groups selected from alkyl, alkenyl, aryl, aralkyl, alkoxy, aryloxy, acyl, acyloxy, amide, tertiary amine, nitro, or halogen, and may be fused to one or more additional rings;

with a hexacoordinate complex of a metal selected from tungsten (0), chromium (0), and molybdenum(0),

whereby said complex undergoes a ligand exchange reaction, such that L¹ becomes coordinated to